

REMARKS

Claims 29, 30, 32-39, 41-45, 48-52, 54-57 and 59-64 are pending in the present application. Claims 31, 40, 46, 47, 53 and 58 have been canceled. Claims 29, 30, 32-39, 41-43, 48-52, and 54-57 have been amended. Claims 59-64 have been added.

1. Claims 30-48 and 50-58 stand rejected under 35 CFR 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter to which Applicants regard as the invention.

Claims 30-48 have been amended to variously depend from claim 29. Also, Claims 50-58 have been amended to variously depend from claim 49. Applicants submit that this rejection is now moot.

2. Claims 46 and 58 also stand rejected under 35 CFR 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter to which Applicants regard as the invention.

Claims 46 and 58 have been canceled, and therefore this rejection is now moot.

3. Claim 49 also stands rejected under 35 CFR 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter to which Applicants regard as the invention.

Claim 49 has been amended to clearly define the present invention. Applicants submit that this rejection is now moot.

4. Claims 49 and 50 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Bool et al. (US 2002/0073938).

Regarding independent claim 49, Examiner contends that Anderson et al. discloses all the limitations of this claim, except that Anderson et al. does not “explicitly disclose wherein the oxygen transport membrane extracts oxygen from pressurized air provided thereto.” Specifically, Examiner notes that Anderson et al. “teaches that air is supplied (Column 6, lines 3-4), but does not

explicitly disclose that it is pressurized.” Examiner further contends that Bool et al. teaches that “the supplied air must be compressed, for instance by a blower instead of a compressor” (paragraph [0011], lines 3-6). Examiner therefore, concluded that “it would have been obvious to one having ordinary skill in the art at the time of the invention to provide pressurized air to the transport membranes of Anderson in order to drive the transport of oxygen through the membrane as taught by Bool et al.” Applicants respectfully traverse Examiner's rejection.

Examiner contends that Anderson et al. discloses an oxygen transport membrane (140) being disposed such that the firebox (12) provides sufficient heat for the oxygen transport membrane, as recited in amended claimed 49. Specifically, Examiner notes that the membrane receives steam from boiler (10) through ducts (138) (column 5, lines 49-51). Applicants acknowledge that Fig. 2 shows the input of the oxygen source 140 is identified with reference numeral 138, however, Applicants contend that the input to the oxygen source 140 is mislabeled because it is inconsistent with the written description. Upon closer review of the cited language of Anderson et al. “Steam is conducted from the circulating fluidized bed steam generator 10 to the turbine 136 via a plurality of ducts 138 and injected there-against to drive the turbine.” (column 5, lines 49-51)), steam is provided to the turbine and not the oxygen source 140. Anderson et al. further discloses that “(The oxygen (O₂) supplied by the oxygen source 140 is preferably created by an **air separation process** performed by an air separation unit which separates oxygen (O₂) from **an ambient air feed stream** and, in this regard, the oxygen source 140 can be configured, for example, as a **cryogenic** plant...” (emphasis added) (column 6, lines 1-7) Applicants contend that the input line labeled 138 is the ambient air input as described in the specification, and not the steam provided to the turbines.

As such Anderson et al. do not teach or suggest heating the oxygen transport membrane as claimed by Examiner. This lack of teaching or suggestion is further supported by the fact that the oxygen supplied by the oxygen source 140 is preheated downstream of the oxygen introducing elements by a pure oxygen preheater 144. (column 6, lines 12-14) In fact, if the separation process functions as suggested by Examiner, the temperature of flue gas passing through line 150 (after the backpass 22) would be **less** than the temperature of the steam and thus the oxygen exiting the oxygen source 140. Consequently, the pure oxygen preheater 144 would **cool the oxygen rather than preheat the oxygen** as described in Anderson et al. (column 6, lines 12-21)

Based upon the disclosure of the written description of the steam generator and oxygen source, Applicants contend that Anderson et al. does not teach or suggest a firebox in which solid fuel is combusted to provide sufficient heat for the oxygen transport membrane, as claimed by Applicants.

Anderson et al. further provides no motivation to provide heat to the oxygen transport membrane. In fact, the use of an oxygen preheater 114 (see Fig. 2) in Anderson et al. teaches away from heating the oxygen source 140 (e.g., oxygen transport membrane), as claimed by Applicant. Therefore, one skilled in the art would not look to Bool et al. Furthermore, Anderson et al. provides no teaching of a specific oxygen transport membrane, and thus there is no suggestion that pressurized air is needed, and therefore, one skilled in the art would not look to combine the teachings of Bool et al. with that of Anderson et al.

Furthermore, neither Anderson et al. or Bool et al. provide heat to the oxygen transport membrane from a firebox in which solid fuel is combusted in the presence of oxygen.

Applicants therefore respectively assert that claim 49 is patentable over Anderson et al. in view of Bool et al. for at least these reasons. It is respectfully requested that this claim be reconsidered and allowed.

5. Claim 50 depends on independent claim 49, and therefore, is patentable over Anderson et al. in view of Bool et al. for at least the reasons provided hereinbefore. It is respectfully requested that these claims be reconsidered and allowed.

6. Claims 29-35, 39, 41, 47, 49, 54, and 57 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938).

Regarding independent claim 29, Examiner contends that Anderson et al. discloses all the limitations of this claim, except that Anderson et al. does not “disclose a transport membrane being disposed in the fluidized bed” nor “explicitly disclose that pressurized air is provided to the transport membrane.” Examiner then contends that Adris et al. teaches “a transport membrane being disposed in the fluidized bed.”

Examiner therefore, concluded that “it would have been obvious to one have in ordinary skill in the art at the time of the invention to provide pressurized air to the transport membranes of Anderson in order to drive the transport of oxygen through the membrane as taught by Bool et al.” Furthermore, Examiner, concluded that “it would have been obvious to one have in ordinary skill in the art at the time of the invention to provide pressurized air to the transport membranes of Anderson in order to drive the transport of oxygen through the membrane as taught by Bool.” Applicant respectfully traverses Examiner's conclusions, as well as traverses a conclusion that one have ordinary skill would combine all three references.

Applicants submit that it would not have been obvious to one skilled in the art to combine the three (3) cited references to provide Applicants' claimed invention. Anderson et al. show an oxygen fired circulating fluidized bed steam generator having an oxygen source 140 whereby oxygen “is preferably created by an air separation process performed by an air separation unit which separates oxygen (O₂) from an ambient air feed stream and, in this regard, the oxygen source 140 can be configured, for example, as a cryogenic plant ...” (column 6, lines 1-6) As noted above, Anderson et al. does suggest the use of an oxygen transport membrane for producing oxygen (column 6, lines 9-11), but does not teach or suggest that the membrane is disposed in a fluidized bed of heated solids, or even that the oxygen source (e.g., oxygen transport membrane) is heated at all. Therefore, Applicants contend that one skilled in the art would not look to Adris et al. to dispose the oxygen transport membrane of Anderson et al. in a fluidized bed having heated solids. Furthermore, one skilled in the art would not look to combine the pressurized air in Bool et al. with Adris et al. because the system of Adris et al. would not function as intended because the system of Adris et al. draws hydrogen with a negative pressure from the circulating bed into the separation tubes 30. (column 3, lines 53-60). In addition, one skilled in the art would not look to a system for producing hydrogen for a system to produce oxygen for combustion in a fire box of a circulating fluidized bed boiler.

Applicants further contend that even if it would have been obvious to combine the three references, Applicants claimed invention would not result. Applicants' claimed invention of claim 29, as amended, includes “an oxygen transport membrane disposed in the fluidized bed, wherein the heated solids sufficiently heat the oxygen transport membrane such that the oxygen transport membrane extracts oxygen from pressurized air provided thereto for combustion in the firebox.” (emphasis added) While Adris et al. provide a membrane in a fluidized bed, Adris et al. (nor

Anderson et al. and Bool et al.) do not teach or suggest an oxygen transport membrane that extracts oxygen from pressurized air and provides the oxygen to the fluidized bed. To the contrary, Adris et al. shows a hydrogen membrane that separates hydrogen from the fluidized bed to an outlet line 31. (column 3, lines 53-66) In fact, if the hydrogen transport membrane of Adris et al. is substituted with an oxygen transport membrane, as suggested by Examiner, the combined system would draw oxygen away from the fluidized bed, and thus teaches away from the claimed invention.

Furthermore, the fluidized bed section 12 of Adris et al. is filled with particles 26 of catalyst used for the reaction to be performed; and these particles are fluidized by introducing the reacting gases to form the fluidized bed. (column 3, lines 41-44) Contrary to the claimed invention, as newly amended, the system of Adris et al. require the particles 26 to be heated by using heat pipes or heat exchangers 36 embedded within the bed 12 and serviced by circulating a thermal fluid 38. (column 5, lines 20-26) However, Applicants' claimed invention of claim 29 provides a boiler that sufficiently heats the oxygen transport membrane with heated solids contained within a flue gas generated by the combustion of solid fuel. Neither Anderson et al., Adris et al. or Bool et al. teach or suggest such limitation.

Applicants therefore respectively assert that claim 29 is patentable over Anderson et al. in view of Adris et al. and Bool et al. for at least these reasons. It is respectfully requested that this claim be reconsidered and allowed.

Regarding independent claim 49, Examiner contends that Anderson et al. discloses all the limitations of this claim, except that Anderson et al. does not extract oxygen from pressurized air provided thereto and does not provide thermal communication between the solids heated in the firebox and the transport membranes.

Applicants submit that combining the three (3) cited references would not result in the Applicants claimed invention. As noted in the above arguments and contrary to Examiner's contention, Anderson et al. does not suggest or teach that thermal heat from the boiler is provided to the oxygen source 140 of Anderson et al. Therefore, one skilled in the art would not look to heat the oxygen source or provide heat from the firebox to the oxygen transport membranes, as claimed.

Furthermore, Applicants contend that one skilled in the art would not combine Anderson et al. Bool et al., and Adris et al. to provide Applicants invention recited in claim 49. Specifically, one skilled in the art would not look to extract oxygen (or hydrogen in the case of Adris et al.) for use in the combustion process in a firebox, wherein each of the three cited reference teach or suggest

different methods of extracting oxygen/hydrogen. Anderson et al. suggests extracting oxygen using an oxygen membrane to extract oxygen from an ambient air stream (Column 6, lines 1-4), with no teaching or suggestion of pressurized air. Bool et al. provides pressurized air to an oxygen membrane to extract oxygen in a combustion chamber. Further to the contrary, Adris et al. uses a pump to create a **negative pressure** to draw hydrogen away from a fluidized bed (column 3, lines 53-66). Applicants therefore submit that it would not have been obvious to combine a system that extracts oxygen from an ambient air stream using an oxygen transport membrane, with a system that extracts oxygen from pressurized air using an oxygen transport membrane, and further with a system that extracts hydrogen from the combustion chamber having a fluidized bed. In fact, Applicants contend that Anderson et al. teaches away from combining Bool et al. and/or Adris et al.

Furthermore, the combination of these references would not result in the Applicants' claimed invention. For example, the replacement of the hydrogen transport membrane with an oxygen transport membrane would result in the oxygen in the combustion chamber being removed from the combustion chamber where the combustion of solid fuel in the presence of oxygen takes place.

Applicants therefore respectively assert that claim 49 is patentable over Anderson et al. in view of Adris et al. and Bool et al. for at least these reasons. It is respectfully requested that this claim be reconsidered and allowed.

7. Claims 30, 32-35, 39, 41, 54, and 57 variously depend on independent claims 29 and 49, and therefore, are patentable over Anderson et al. in view of Adris et al. and Bool et al. for at least the reasons provided hereinbefore. It is respectfully requested that these claims be reconsidered and allowed.

Claims 31 and 47 have been canceled, and therefore this rejection is now moot.

8. Claims 36 and 52 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Belin et al. (US 6,532,905).

Claims 36 and 52 depend on independent claim 29 and 49 respectively, and therefore, are patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Belin et al. for at least the reasons provided hereinbefore. It is respectfully requested that these claims be reconsidered and allowed.

9. Claim 37 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Hyppanen (US 5,476,639).

Claim 37 depends on independent claim 29, and therefore, is patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Hyppanen for at least the reasons provided hereinbefore. It is respectfully requested that this claim be reconsidered and allowed.

10. Claim 38 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Dietz (US 5,054,436).

Claim 38 depends on independent claim 29, and therefore, is patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Dietz for at least the reasons provided hereinbefore. It is respectfully requested that this claim be reconsidered and allowed.

11. Claims 40 and 53 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Prasad et al. (US 5,852,925).

Claims 40 and 53 have been canceled, and therefore this rejection is now moot.

12. Claims 42 and 55 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Rogut. (US 5,284,583).

Claims 42 and 55 depend on independent claims 29 and 49 respectively, and therefore, are patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Rogut for at least the reasons provided hereinbefore. It is respectfully requested that these claims be reconsidered and allowed.

13. Claims 43-45 and 56 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Besecker et al.. (US 7,125,528).

Claims 43-45 and 56 depend on independent claims 29 or 49, and therefore, are patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Besecker et al. for at least the reasons provided hereinbefore. It is respectfully requested that these claims be reconsidered and allowed.

14. Claims 46, 48, and 58 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Bauer et al.. (US 5,108,465).

Claim 48 depends on independent claim 29, and therefore, is patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Bauer et al. for at least the reasons provided hereinbefore. It is respectfully requested that this claim be reconsidered and allowed.

Claims 46 and 58 have been canceled, and therefore this rejection is now moot.

15. Claim 51 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Anderson et al. (US 6,505,567) in view of Adris et al. (US 5,326,550) and Bool et al. (US 2002/0073938) and further in view of Garcia-Mallol (US 5,239,946).

Claim 51 depends on independent claim 29, and therefore, is patentable over Anderson et al. in view of Adris et al. and Bool et al. and further in view of Garcia-Mallol for at least the reasons provided hereinbefore. It is respectfully requested that this claim be reconsidered and allowed.

16. Newly added dependent claims 59-64 depend on independent claims 29 or 49, and therefore, is patentable for at least the reasons provided hereinbefore. It is respectfully requested that this claims be allowed.

17. A petition for a second and third month extension of time is provided herewith. Please charge the fee of \$900.00 for the petition for an additional two-month extension of time to Deposit Account No. 03-2578 Order No. VA30455. Any deficiency or overpayment should be charged or credited to this Deposit Account.

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